Horsefly Coho

Distribution:

Worldwide:

Coho salmon populations are found throughout the North Pacific basin, especially in the east along the Alaska, B.C., and United States south to the Sacramento River. While they occur naturally only in the Pacific Oceans, they have been transplanted to other areas, in particular the area around Japan, coastal Chile (aquaculture industry), and most notably the Great Lakes. Adult coho are three years old, usually weigh from 2 – 5 kg, and they are an important sport and commercial salmon species.

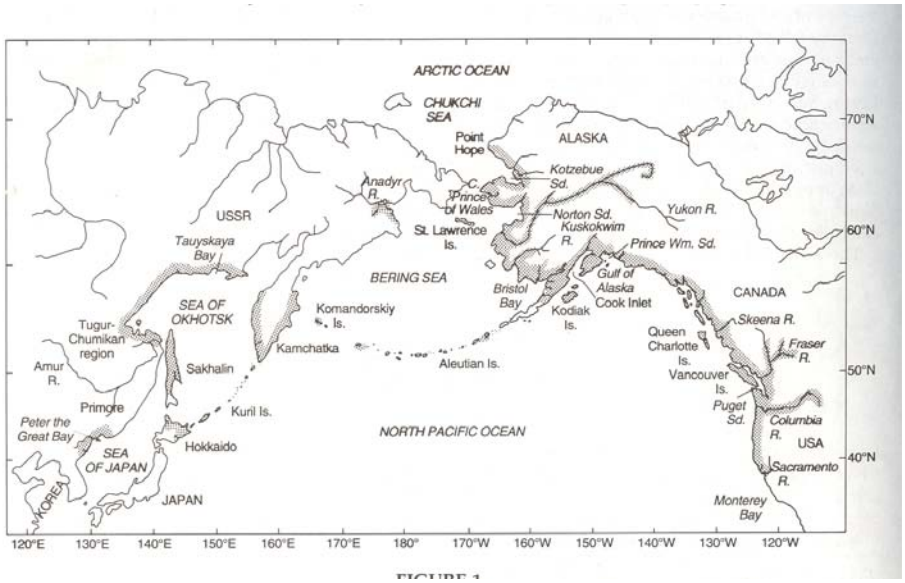

Figure 1. Distribution of Coho Salmon in the North Pacific Ocean.

Coho salmon are native to the north Pacific, but have been widely transplanted.

Since salmon pass through international waters, and are harvested by at least one other country besides Canada, the federal government is directly involved in their management. The right to fish Fraser River salmon is governed by treaties between Canada and the United States, First Nations fishery agreements, as well as other mechanisms. Catch allocation between the major fleets is addressed politically through a series of consultations between government, first nations and industry groups, supported by technical science advisors from two countries.

Coastal B.C.

Overall the harvest rate on Fraser River coho salmon is now less than 10%, which represents a considerable change in the last 10 years when the harvest rate ranged from 40 – 80%. Now, there are no commercial

fisheries that target coho salmon. Furthermore, fisheries scientists also focus on the careful management of larger, identifiable stocks where coho are an interception catch. In coastal B.C., the following factors are taken into consideration:

- The timing and abundance of sockeye stocks that migrate together with summer-run coho salmon, many of which are returning to the Thompson River.
- The timing and abundance of coastal chum stocks that migrate together with winter-run coho, some of which are returning to the Upper Fraser above the Thompson confluence.
- The capacity of mixed-stock sport and troll fisheries in various areas is also a consideration, since it is characteristic of coho salmon that the larger run is composed of many smaller populations, each susceptible to overfishing.

Since 1998, much commercial fishing has been foregone in the interest of conserving interior Fraser coho.

It is important to note that interior Fraser coho have been recovered in fisheries from Alaska to Oregon, but most were caught off the west coast of Vancouver Island and in the Strait of Georgia. It is beyond the scope of this summary to examine the details of fishery management and organization any further. The remainder of the population is called the escapement: this term refers to the spawning population that survives to reproduce in freshwater.

Coastal coho populations, which are resident in the lower Fraser are not considered further in this paper.

Interior Fraser River Escapement:

Populations:

The outlook for interior Fraser coho is highly uncertain and depends on fishing, habitat perturbations and climate related changes in survival. In response to conservation concerns, exploitations were reduced significantly beginning in 1997 and then reduced as far as possible by 2000. By then, the interior Fraser River escapement dropped to less than 20,000 spawning coho annually (see large-scale map and table below). The main reason for the decline in numbers is excessive fishing that resulted when harvest rates were not reduced quickly in response to climate-driven declines in marine survival. However, freshwater habitat degradation has played a role – coho declines are also related to the intensity of human disturbance in the watersheds. Current predictions for the 2008 salmon season are poor.

Interior Fraser River coho are recognized as a genetically distinct group that is made up of at least five subpopulations. Slightly more than half of recent estimates of the total population of about 20,000 wild fish occur within the North and South Thompson watersheds. Their distribution in

non-Thompson Fraser tributaries is not well known. Coho salmon occur at least as far upstream as the Nechako River, but there are several major upper Fraser watersheds where coho probably occur but their presence has not been confirmed.

Table 1. Estimated fishery exploitation rates and escapement[1] of interior Fraser River coho *(unreleased figures, for illustration purposes only).*

Return year	Expoitation rate (%)	Thompson Escapement	Non-Thompson Escapement	Total Interior Fraser River Coho Escapement
1984	68	90,101	Unknown	Unknown
1985	68	64,071	Unknown	Unknown
1986	66	122,999	Unknown	Unknown
1987	54	71,179	Unknown	Unknown
1988	71	99,051	Unknown	Unknown
1989	65	51,308	Unknown	Unknown
1990	74	38,727	Unknown	Unknown
1991	68	22,539	Unknown	Unknown
1992	81	38,833	Unknown	Unknown
1993	88	19,958	Unknown	Unknown
1994	43	19,768	Unknown	Unknown
1995	56	28,083	Unknown	Unknown
1996	83	15,288	Unknown	Unknown
1997	40	12,973	Unknown	Unknown
1998	7	16,699	8,147	24,846
1999	9	16,997	5,389	22,386
2000	3	15,276	4,723	19,999
2001	10	49,496	13,515	63,011

Interior coho salmon are a genetically distinct population, and their survival is not assured.

[1] Irvine, J.R. 2002. COSEWIC Status Report on Coho Salmon *Oncorhynchus kisutch*, from the Interior Fraser River Watershed, B.C. 39p. DRAFT MANUSCRIPT,

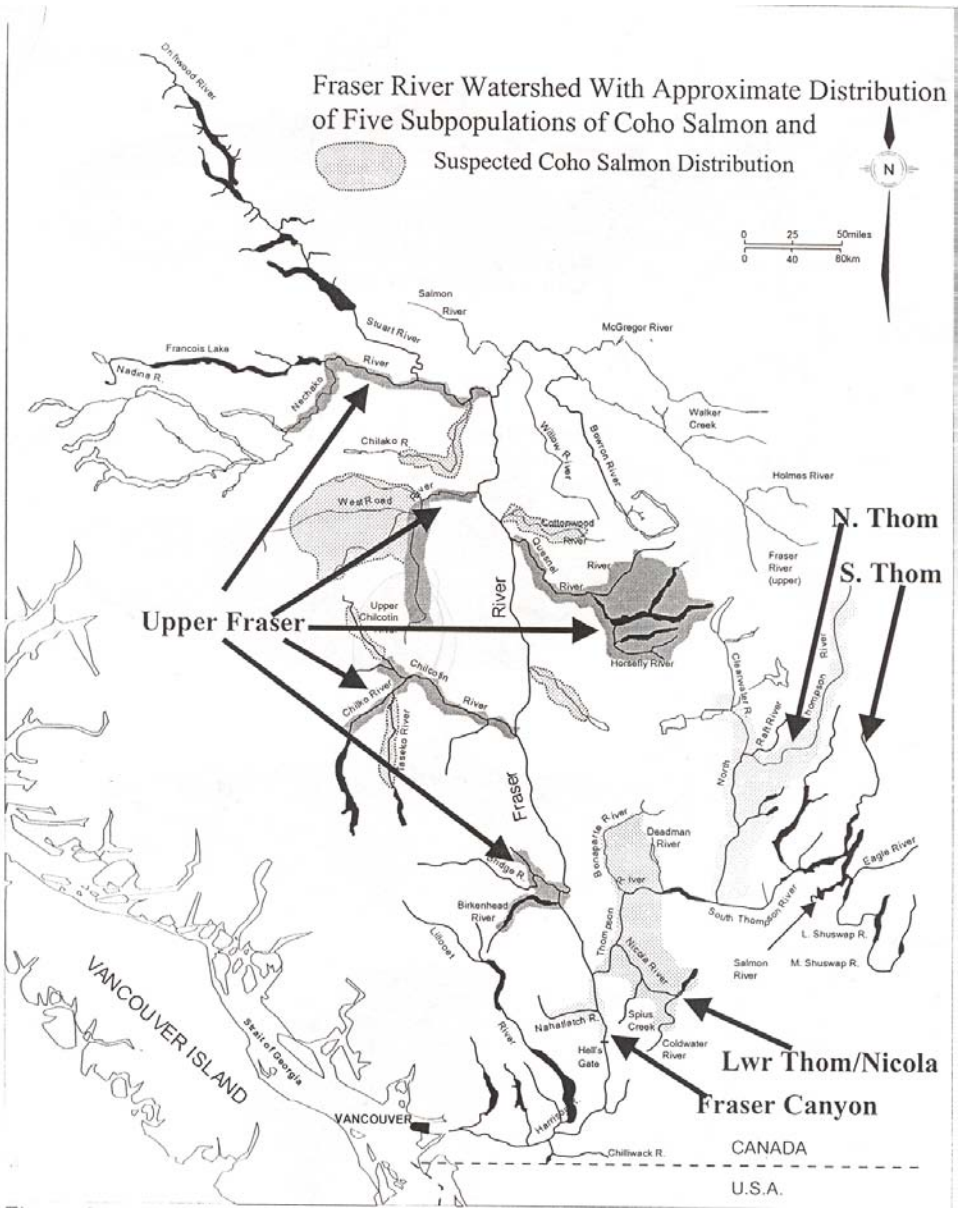

Figure 2. Approximate distribution of 5 subpopulations of coho salmon within the interior Fraser River watershed.

Age composition:
Most coho in the interior Fraser River share the same life history pattern: 6 months of egg incubation; more than one full year rearing in the stream; followed by outmigration and eighteen months in the ocean, returning in the fall as 3-year old fish. Jacks (precocious males) that spend only six months in the ocean are found in some populations.

Spawning and Incubation

Upstream Migration:

Interior Fraser coho return to the lower Fraser River in October, and show up at their spawning streams in late October – November period. Since fish may arrive when the winter ice is on the rivers, counting and identifying coho populations has always been difficult. There are earlier-migrating coho salmon in some of the systems, but they are still characteristically later than the other species.

In the interior Fraser, coho migrate late in the year, often under river ice. Counting spawners is a challenge.

Like all the salmon, they cease feeding before entering freshwater and depend on their energy reserves for migration, maturation of gonads, spawning and redd defence until death. Coho salmon maintain good quality flesh and flavour for a substantial part of the upstream movement and are fished to some extent by First Nations people.

Spawning behaviour is similar for all the salmon species, but coho salmon are difficult to spot from a distance, due to their habit of occupying small stream areas, and migrating late in the year.

Horsefly Escapement:

Generally, the distribution of spawning habitat for coho salmon is clumped with a watershed. Juvenile coho salmon tend to cluster in areas of suitable habitat near shallow gradient streams and sometimes lakes. It is worth noting that much of the interior Fraser watersheds where coho are found has been logged and is now used for a variety of agricultural activities.

We can find spawning coho salmon in the Horsefly River mainstem, near the confluences of Tisdall, Wilmott and Patenaude Creeks, about 2-3 km downstream of the McKinley Creek confluence. They have also been observed spawning further upstream in Tisdall Creek.

McKinley Creek is an important coho producer.

McKinley Creek is a large sub-basin which contains a population of coho that are counted separately. Spawners can be seen in McKinley Creek at the lake outlet, and along the McKinley Lake shore near the Offset Creek confluence. Further upstream, Molybdenite Creek also contains spawning coho, as well as Upper McKinley Creek near the Elbow Lake outlet.

DFO's Stock Assessment Division runs a counting fence on McKinley Creek in order to count the number of returning coho spawners. This serves as an "indicator" stream that is intended to reflect interior coho population dynamics. Prior to 1998, escapement counting methods were sporadic and not directed at counting coho; accordingly, historic data for this watershed is omitted in this report.

Table 2. Annual coho escapements for the Horsefly River and McKinley Creek populations.[2]

Return Year	Horsefly River	McKinley Creek
1998	185	790
1999	400	212
2000	638	223
2001	597	1,989
2002	525	1,453
2003	18	642
2004	678	1,523
2005	107	498
2006	40	273
2007	367	5,050
2008	27	391

Incubation:

DFO is still in the process of identifying critical habitats for this unique population, so it is risky to identify factors that may affect coho egg incubation in the interior Fraser, and how that might alter population dynamics.

However, coho salmon incubation has been studied in other areas, and it is known that there is a large variation in egg-to-fry survival rate that is related to stream habitat conditions. In particular, gravel size and shape, and the corresponding interstitial spaces, is important: coho alevins, like some of the other salmonids, can migrate more than 20 cm through the gravel after hatching into alevins. This movement seems to be a survival mechanism, as incubation mortality increases significantly where fine sediment or sand plugs these spaces.

All the salmon species have fertilized eggs that there are very shock-sensitive, so we expect that there would be some mortality following

[2] Personal communication, Richard Bailey, DFO Sr. Stock Assessment Biologist, Kamloops.

successful egg deposition as a result of floods, ice jams and other events that move bedload material.

Freshwater residence

Fry migration and freshwater life

Coho salmon spend about 14 months rearing in freshwater streams. This places them in extremely vulnerable habitats for extended periods and it is perhaps because of this feature of their biology that they have been extensively studied in the Pacific Northwest. While most of the following applies to coastal rivers and creeks, it provides some insight into what governs the behaviour of coho salmon, and why this is important to watershed managers. Note that research is continuing on the habitat preferences and movements of interior coho and more information is forthcoming.

Horsefly Watershed Distribution

Juvenile coho salmon can be found in many locations in the McKinley watershed, including Molybdenite Creek: the upper extent of their distribution has not been determined. The mainstem Horsefly population appears to migrate to rearing areas in Tisdall, Patenaude, Woodjam, Moffat, and many unnamed creeks tributary to the lower Horsefly River below the 27 km falls.

Habitat Utilization:

In coastal systems, juvenile coho salmon are known for their aggressive, territorial behaviour. They live in small streams, often in gently-flowing pools, and orient behind logs and rocks, and will defend and maintain territories. Since they inhabit structurally complex streams, juvenile coho production is limited by the number of suitable territories available. Where this has been measured in other areas, estimates range from 8.4 - 8.5 smolts/100m^2, to 18 – 67 smolts/m^2, to 125 – 141 smolts/100m^2 in nutrient-rich, stable streams. As conditions change and more fish arrive (e.g. flooding, or fry emergence), coho juveniles are progressively displaced downstream into less favourable sites. Young coho that reach the estuary environment while still "young-of-the-year" are not well equipped to survive saline conditions, although research is continuing on this point.

Coastal juvenile coho establish and defend territories. Interior coho may be quite different.

Interior coho may have very different behaviours. Interior watersheds are governed by a snowmelt-dominated hydrograph, in contrast to coastal streams with rainfall-dominated flood events at different times of the year. Since approximately 2003, DFO has partnered with the Northern Shuswap Tribal Council and a number of graduate students. Topics include microhabitat preferences, behavioural studies, juvenile/adult recruitment

studies in the McKinley Creek system with a view to establishing a better understanding of interior coho freshwater biology.

Feeding and Growth:
Generally, coho in freshwater are visual feeders, and prefer picking prey items off the waters' surface or in the drift. In freshwater, the primary food is insects (aquatic and terrestrial). Small streams primarily overhung with terrestrial vegetation are generally the most productive. Older, larger, juveniles and smolts become piscivorous. They are known to eat 1.5 – 2 fry per day (emergent trout or salmon).

Coastwide data indicate that coho salmon emerge at about 3 cm in the early spring, and migrate 14 months later, the following May, at a fork length between 10 – 13 cm. There is a period of no growth or feeding in midwinter.

Freshwater Survival Factors:
Overall, the survival rate from fry to smolt is low, and has been measured in coastal streams at 1 – 2%. On the coast, survival factors are correlated with stream discharge. Low numbers of adults two years later can be correlated with both low water, warm summer environments and sometimes fall flooding. In interior streams, high stream temperatures in the summer (lethal level is 25^{o}C), often occur.

Off-channel habitat such as pools that dry up over the season are responsible for significant loss from predators such as birds, garter snakes, etc. Generally, predators take a fixed number of prey: the implication of this is that where small numbers of fish are concentrated in the wrong spots, predators can eliminated the population entirely.

Beaver ponds also provide excellent habitat; however, this is counterbalanced by mortality from predators.

Identification:
After emergence and early in the season, coho fry they have a silver or gold body, long vertical parr marks, and fins tinged with orange. The long, close parr marks can be very distinctive. The anal fin is long, sickle-shaped, and edged with white, bounded by a black line. These characteristics are associated with extreme territoriality, and in conditions where coho have these behaviours they are fairly easily distinguished.

Unfortunately, juvenile coho salmon in the interior Fraser River have a more variable appearance which changes between and within watersheds, and from season to season. They have been confused with juvenile Chinook salmon, and are now the subject of DNA testing to fine-tune identification parameters.

Figure 3. Juvenile Chinook salmon (top) and coho salmon (bottom) in interior Fraser River.

Coho Salmon Hatcheries

Hatchery Technology

Salmon hatcheries are designed to provide high survival environments in freshwater and in Canada they are publicly supported by DFO. Hatchery facilities are high-technology structures that are carefully designed to include engineered egg incubation systems, rearing contains for fish of different sixes and species, structured feeding programs, pre-release marking, etc. In B.C. they have been used successfully to increase the freshwater survival of selected wild, native stocks of coho salmon (as well as Chinook and chum salmon, and other salmonids).

Modern hatcheries use "strategic enhancement": that is, they integrate hatchery and naturally-produced components of endemic wild stocks of Pacific salmon. In conjunction with improvements in habitat and harvest management, this approach is specifically designed to enhance the freshwater productivity of wild, native salmon stocks. While fish reared

in a hatchery may appear slightly different (e.g. body size, shape or colour, or in some behaviours) because of artificial rearing conditions, they are genetically the same as their naturally-produced cousins, and these superficial differences fade away as the fish adapt to new oceanic conditions.

The Spius Creek Hatchery
The Spius Creek Hatchery is located in Merritt, has been operating since 1982 and produces about 400,000 juvenile chinook salmon and 200,000 coho salmon. Enhanced stocks are located in the Thompson River drainage only.

Coho are widely produced in hatcheries. Production is limited by hatchery capacity, and available brood stock.

The Horsefly Sockeye Spawning Channel
Spawning channels also provide some rearing habitat for coho salmon, and the Horsefly channel is no exception. While its main features are intended to maximize sockeye spawning success, controlled flow, graded gravel and stable bank structure also provide habitat for some stream-rearing salmonids, including coho salmon.

Coded-wire tagging
Conventional hatcheries allow easy access to large numbers of juvenile coho salmon for marking with tiny coded tags that are identified by a missing adipose fin on the adults. By international agreement, there is a coordinated effort to recover marked fish throughout the north Pacific. The tag recovery data identifies migration patterns, exploitation rates, survival indicators, etc. which then forms the basis for other fishery management decisions.

Seaward Migration

Coho salmon do not migrate to sea during their first year of life but delay migration until the spring following their emergence from the gravel, after about 14 months of rearing in freshwater streams. Typically, this is in April or May when juveniles rise to the surface at night and begin moving downstream in schools. Realistically, there are very low numbers of yearlings and older migrants observed in the Horsefly and biological cues to migration are difficult to judge.

For rivers that are in the upper reaches of a large system, it is important to distinguish a smolt that is physiologically and behaviourally ready to accept introduction to saltwater, from a juvenile that is migrating to another freshwater area for rearing. Active downstream migration from the upstream reaches may well occur long before physiological readiness for saltwater can be demonstrated.

Ocean Residence

Growth is rapid once yearing smolts reach the Fraser estuary. However, they are vulnerable to predation by many of the same predators that they faced during their freshwater rearing and migration states (fish, birds, small mammals). Most juvenile coho remain in the estuary eelgrass beds and tidal channels for a period of days or weeks, and move to inshore marine areas fairly quickly. Overall, interior Fraser coho spend two summers at sea before returning to the Fraser River to begin their spawning journey.

Outlook

The extreme management measures undertaken in B.C. during 1998 to conserve coho appear to have stemmed the decline for some populations. Numbers of coho in the Upper Fraser/ Thompson may be larger than previously thought, but those streams with very few fish in them continue to be at risk of local stock extinction.

Interior coho salmon are listed as "endangered" by COSEWIC, but are not currently listed as a protected species under the Species at Risk Act (SARA) for socio-economic reasons.

References

R. Bailey, Sr. Stock Assessment Biologist, DFO Kamloops, personal communication.

Irvine J.R. 2002. COSEWIC Status Report on Coho Salmon *Oncorhynchus kisutch*, from the Interior Fraser River Watershed, B.C. 30p,. DRAFT MANUSCRIPT.

Sandercock, F.K. 1991. Life History of Coho Salmon *(Oncorhynchus kisutch)*, pp 447 – 522. IN Groot, C. and L. Margolis (Eds.), Pacific Salmon Life Histories, U.B.C. Press ISBN 0-7748-0359-2.

Shepherd, B.C., J.E. Hillaby and R.J. Hutton. 1986. Studies on Pacific Salmon *(Oncorhynchus spp.)* in Phase I of the Salmonid Enhancement Program. Volume 1: SUMMARY. Can. Tech. Rep. Fish. Aquat. Sci. No. 1482: vii + pp 1-180 (Two Volumes).